WORLD WIDE WEAVE

The war on microplastics

How woven solutions sustainably improve drinking water quality

By Dominik Herper

They're everywhere. In packaging, bottles, clothes, electronic devices, cars, building materials, or even cosmetics: plastics. Humans have been using this class of materials for over 60 years and we can no longer imagine life without them. This is because plastics, unlike other groups of materials, have an extremely broad array of material properties and can therefore be used for a whole range of applications. This characteristic – along with their generally low cost and good workability – has led to plastics being used to a massive extent in more and more areas in recent decades. Whereas annual global plastic production stood at just 2 million tons in 1950, some 380 million tons of plastic were produced around the world in 2015.[1]

This is not without consequences. As a result of this massive production and use, a large proportion of the products made from plastic, or parts of them, have found their way into global ecosystems. Just as we find plastics in virtually every application, so is the plastic pollution they cause omnipresent. This waste is particularly damaging to aquatic ecosystems. Plastics have a relatively low density (between 0.8 g/cm³ and 2.2 g/cm³), which means that they are carried away especially easily with draining water. Initially, this water carries plastic waste into surface waters such as lakes or rivers, from where it ultimately ends up in the oceans. Estimates state that around ten percent

[1] Roland Geyer et al.: Production, use, and fate of all plastics ever made; Science Advances; Volume 3, 2017

of annual plastic production lands in the world's oceans.[2] The plastic parts accumulate there to form giant islands of waste such as the Great Pacific Garbage Patch. So it's hardly surprising that plastic pollution constitutes around 80 percent of the total waste found in aquatic systems.[3] The problem of the contamination and pollution of aquatic ecosystems by plastic products such as bags, bottles, packaging, etc. has already been the object of discussion and research for some time; avoidance and removal strategies have been and continue to be developed.

A problem that has been largely neglected up until now, however, is the fact that not just macroscopic plastic parts such as bottles but also microscopically small plastic particles are carried into waters in the same way. These particles are known as microplastics.Microplastics include all plastic particles that do not exceed five millimeters in length at their largest extent. A distinction is also made between primary and secondary microplastics. Primary microplastic – usually used as an abrasive or filling agent – is a component of cosmetics, care products, and cleaning products. Secondary microplastic comprises all plastic particles that arise through biological, physical, and/or chemical degradation. Prominent examples include synthetic fibers that detach from textiles during washing but also plastic that wears from tires or shoes. Secondary plastic forms the lion's share of contamination. The effects of microplastic on biological organisms are currently a hot topic of discussion and still need to be backed up scientifically. Yet it is known that marine animals mistake microplastic particles for food and ingest them. This can lead to internal injuries and even obstruction of food intake. Fish that we catch for food also take in not inconsiderable amounts of microplastic. A study shows that microplastic

[2] Raveender Vannela: Biosphere-Level Effects and Global Policy Challenge from Plastic(s) in Oceans; Environ. Sci. Technol., 2012, 46 (15), pp 7932–7933
[3] Holm, Patricia; Schulz, Gerhard; Athanasopulu, Kiriaki: Meeresverschmutzung der neuen Art: Mikroplastik - ein unsichtbarer Störenfried. In: Biologie unserer Zeit 43 (2013), No. 1, p. 27-33

(HDPE particles) is ingested by mussels and stored in cells and tissue. This resulted in histological changes and inflammatory reactions.[4] Microplastic particles are also suspected of being able to act as carrier substances for pathogenic bacteria.

Even though a large proportion of the water polluted with microplastic is treated in sewage plants, the smallest particles are able to pass through the sewage plant and make their way into surface waters such as lakes and rivers. This is precisely where GKD – Gebr. Kufferath AG is tackling the problem with the OEMP project- Optimized Materials and Procedures for Removing Microplastics from the Water Cycle. One aim of the project is to develop suitable analysis procedures for tracing and characterizing various plastics in treated waste water. As the name of the project suggests, however, the main goal is to develop new materials to retain microplastic more reliably and thus prevent it from contaminating the environment. The OEMP project is funded under the initiative "Materials for a sustainable water management – MachWas" by the Federal Ministry of Education and Research in Germany. A widely varied project consortium has convened to tackle the numerous challenges from a broad array of specialist areas in the project. GKD is not just a technology partner here but is also heading the OEMP project. Together with the Technical University of Berlin, Invent Umwelt- und Verfahrenstechnik GmbH, the German Federal Environment Agency, Berlin Center of Competence for Water, the Federal Institute for Materials Research and Testing, MeierGuss Limburg GmbH, Berliner Wasserbetriebe, Funke Kunststoffe GmbH, and Mecana Umwelttechnik GmbH, pioneering studies and solutions concerning microplastic are being developed.

[4] Nadia v. Moos et. al.: Uptake and Effects of Microplastics on Cells and Tissue of the Blue Mussel Mytilus edulis L. after an Experimental Exposure; Environ. Sci. Technol., 2012, 46 (20), pp 11327–11335

For GKD the focus of the project is the treatment of waste water in the sewage plant. Despite the already high-tech and sophisticated treatment of waste water, the tiniest of plastic particles are still able to pass through sewage plants and flow into rivers, lakes, and ultimately oceans. To find out how much microplastic can actually pass through a sewage plant, a disc filtration system constructed by Invent Umwelt- und Verfahrenstechnik was installed at the most productive sewage plant in Berlin, the Ruhleben sewage plant, in December 2016. The filter discs are fitted with optimized dutch weaves from GKD. They are used to filter the water from the sewage plant run-off, that is to say water that has already passed through all cleaning stages in the treatment plant.

Water filtration in sewage treatment plants poses a particular challenge as high wastewater flow rates need to be dealt with in a sewage plant. Yet to retain the finest plastic particles, extremely fine filter materials must be used. High flow rates in combination with small pore sizes and good separation performance are characteristic of the optimized dutch weaves from GKD. That's why it was decided during the project to develop even finer variants of this weave, with six and eight micrometer apertures. The result is the products ODW 6 and ODW 8. In the disc filtration system at the Ruhleben sewage plant, these two new developments are now undergoing side-by-side comparison with ODW 20, an optimized dutch weave with an aperture of 20 micrometers, which is a standard mesh in wastewater filtration.

The sampling of the real process poses a particular challenge to all project partners. Thanks to the good cooperation in the interdisciplinary team, a number of unforeseen problems were able to be successfully eliminated. It became apparent that methods for taking samples and evaluating them for microplastic in particular were simply not available. As such, the OEMP team

is performing absolutely pioneering work not only in the area of material development but also in the field of sampling, analysis, and analytics.

The newly developed comparative measurements with ODW 20 show that even this standard mesh retains microplastic particles of various sizes. In developing the analytics, it was agreed that the samples would be examined for three common plastics: polypropylene (PP), polystyrene (PS), and polyethylene (PE). Initial tests with ODW 6 showed that the volume of all retained particles is around double that of ODW 20. However it still remains to be determined what proportion of this retained material is composed of plastics.

Findings made so far show just how difficult the subject of microplastic and its scientific technical evaluation is. Yet they also show that microplastic particles have long been widespread in the global ecosystem, particularly in water. If the problem of microplastic in water is to be eliminated, it has already been proven that current sewage treatment technology is not sufficient to do this. Although modern sewage plants already retain around 96 percent[5] of the microplastics carried into them, a higher proportion needs to be aimed for.

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GKD – WORLD WIDE WEAVE

As a privately owned technical weaver, GKD - Gebr. Kufferath AG is the world market leader in metal, synthetic and spiral mesh solutions. Four independent business divisions bundle their expertise under one roof: Industrial Mesh (woven metal mesh and filter solutions), Process Belts (belts

[5] Talvtie, J. a. Heinonen 2014: Synthetic microfibers and particles at a municipal waste water treatment plant; BASE Project; Helcom

made of mesh and spirals), Architectural meshes (façades, safety and interior design made of metal fabrics) and Mediamesh® (Transparent media façades). With its headquarter in Germany and five other facilities in the US, South Africa, China, India and Chile – as well as its branches in France, Spain, Dubai and worldwide representatives, GKD is close to markets anywhere in the world.

For more information:
GKD – GEBR. KUFFERATH AG
Metallweberstraße 46
D-52353 Düren
Tel.: +49 (0) 2421 / 803-0
Fax: +49 (0) 2421 / 803-233
E-mail: industrialmesh@gkd.de
www.gkd.de

Please send a reprint to:
impetus.PR
Ursula Herrling-Tusch
Charlottenburger Allee 27-29
D-52068 Aachen
Tel.: +49 (0) 241 / 189 25-10
Fax: +49 (0) 241 / 189 25-29
E-mail: herrling-tusch@impetus-pr.de

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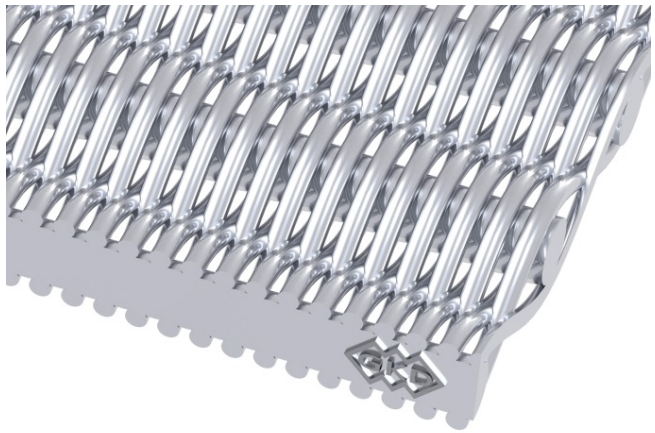
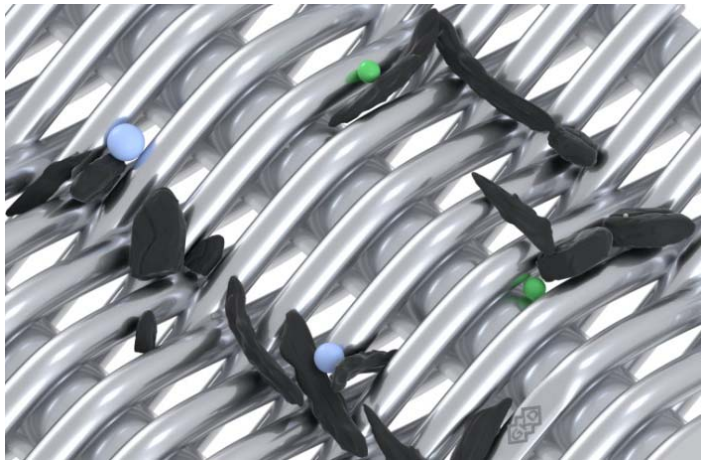


Picture 1: Within the project *OEMP, Optimized Materials and Procedures for Removing Microplastics from the Water Cycle,* GKD developed the optimized dutch weaves ODW6 and ODW8, which are unrivaled in their fineness.



Picture 2: Initial tests with ODW 6 showed that the volume of all retained particles is around double that of the standard mesh ODW 20.

Picture 3: Filter discs, which are used to filter the water from the sewage plant run-off, are fitted with optimized dutch weaves from GKD.

Picture 4: Microplastic is a global environmental problem that GKD, together with many other experts, faces within the funded project *OEMP.*

Picture 1-3 © GKD

Picture 4 © GKD/Bluesky60

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Agentur für Corporate Communications GmbH

Ursula Herrling-Tusch
Charlottenburger Allee 27-29
D-52068 Aachen
Tel: +49 [0] 241 / 1 89 25-10
Fax: +49 [0] 241 / 1 89 25-29
E-Mail: herrling-tusch@impetus-pr.de